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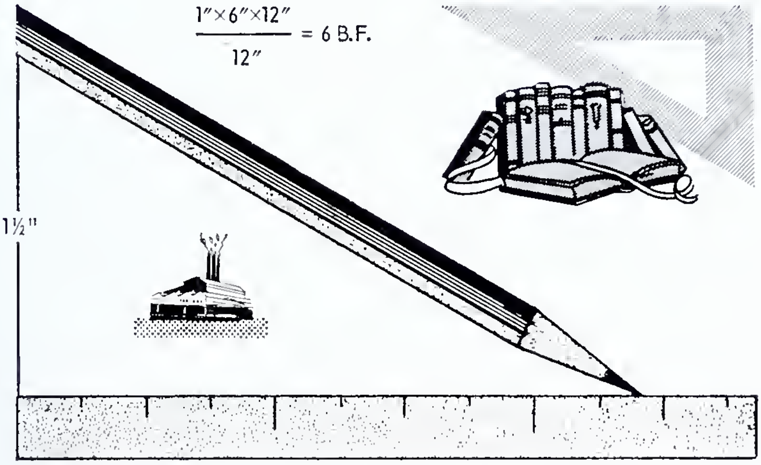
Planning

AS AN AREA OF

INDUSTRIAL ARTS INSTRUCTION IN PENNSYLVANIA PUBLIC SCHOOLS

SUBJECT AREAS

Automotive
Ceramics
Electricity
Graphic Arts
Home Mechanics
Metal Forming
Metal Machining
Planning
Plastics
Sheet Metal
Textiles
Woodworking



Bulletin 331H • 1953

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF PUBLIC INSTRUCTION • Harrisburg

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Foreword

Planning is one of the series of bulletins prepared to stimulate specific areas of instruction in the broad field of Industrial Arts Education. It is a supplement to *Industrial Arts in Pennsylvania,* Bulletin 331, published in September of 1951 by the Department of Public Instruction.

Planning was prepared by William A. Stephenson, Area Coordinator of Trade and Industrial Education, under the supervision of Robert T. Stoner, Chief of Trade and Industrial Education, and under the direction and guidance of Paul L. Cressman, Director of the Bureau of Instruction. Help in the preparation of the manuscript was received from other area coordinators and teachers-in-service who have been successful in this new field in Industrial Arts education. Preliminary work on manuscript and layout planning was done by R. Randolph Karch, Adviser, Trade and Industrial Education. Drawings of shop layouts are the work of Lyle E. Weissenfluh, Adviser, Trade and Industrial Education.

This bulletin has been edited by Rachel S. Turner, Editor for the Department of Public Instruction.

Francis B. Haas
Superintendent of Public Instruction

January 1953

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Introduction

BECAUSE OF THE DIFFERENCES in educational concepts, in backgrounds of the administrator and teacher, in variations in the time pupils spend in the activity, in amount of funds available for equipment and supplies, as well as other factors, no attempt is made in this bulletin to set up a common course of study applicable to all situations or to tell the teacher what to teach, how to teach, or what equipment he should have.

This bulletin does list, in the "Things to Do and Things to Know" section on pages 7 and 8, course content which may be selected by the teacher. These learning units also help to determine specific aims and objectives, amount of time available to pupils in the planning area, and the necessary equipment.

Suggestions to guide the administrator are made on the organization of instruction, instructional material, tools and devices, and the use of records and forms, including examples of Pupils' Planning Sheets. Included for further guidance are a selected annotated bibliography of available instructional material and visual aids, a suggested inventory of equipment and supplies, their approximate cost, feasible planning-area layouts, and other information related to establishing or reorganizing a planning area in a comprehensive general shop.

Matters pertaining to Industrial Arts in general are not discussed in this bulletin. For further information the reader is referred to Bulletin 331, *Industrial Arts in Pennsylvania,* published by the Department of Public Instruction, September, 1951.

1. Planning

IN THE INDUSTRIAL ARTS COMPREHENSIVE GENERAL SHOP

Industrial Arts and the project method of instruction have grown up together. The application of the term *project method* has been generalized to apply to purposeful activity where a pupil's inner urge determines and directs the processes involved in reaching a limited objective. Industrial Arts continues to use projects —articles produced in the school shop—as a means of conveying its objectives.

W. H. Kilpatrick[1] made a major contribution to Industrial Arts education in defining four procedure steps in the development of a project:

(1) Purposing—mind set to an end
(2) Planning—thinking through the steps
(3) Executing—cutting, pounding, filing, making
(4) Judging—was it a success? Could I do better?

This bulletin deals specifically with the organization and development of a shop area to handle the first two steps originally defined by Kilpatrick as *purposing* and *planning.* The two steps are common to all project instruction and all Industrial Arts shop activities. The facilities needed to meet these functions are uniform in every major aspect regardless of the shop organization.

The Significance of Purposing

Well-conceived aims stimulate the organization of procedures and resultant activities. The best ideas for projects are developed in the pupil's mind (purposed) when he is relaxed in pleasant surroundings with suggestive materials in evidence. Chairs, tables, reference books, magazines, pictures, models, an understanding teacher, and the pupil's companions provide the best setting for creative purposes.

On occasion, a boy's purposing will involve discussions with fellow pupils and with his teacher while handling models and investigating a situation. It is a type of informal education which takes plac within the mind of the pupil—the only place where educationa growth can occur.

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[1] KILPATRICK, W. H., *Foundations of Method.* New York City, The Macmillan Co., 1925, Chap. 13.

Purposing and planning are public functions. The teacher plan for the group—but each pupil has the privilege of planning his own work. "Who knows," says Ericson, "after all, which is the most important factor to the majority of pupils, making the plans or executing them?" [1]

Purposing is the highest level of the mental processes, the highest level of industrial management—a quality which has made American industry great. This quality, so closely identified with the American way of life, is the highest point of stimulation to project development in school shop instruction.

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[1] **Ericson, E. E.,** *Teaching Problems in Industrial Arts.* Peoria, Ill., Charles A. Bennett Co., 1930, p. 78.

Planning—A Function of Industry

Purposing would be only daydreaming unless the other steps of the complete project method are developed in proper sequence. When the pupil is motivated to make a project, the next logical step is planning. This stage corresponds with the work of the engineering department in American industry. The following steps in planning are typical:

1. To estimate the possibility of profitable production
2. To rough out a plan of production and distribution
3. To draft a design of an article for approval
4. To make detailed drawings of parts
5. To make a bill of materials and to estimate costs
6. To set up a schedule of work processes
7. To determine available equipment and tools
8. To develop a plant flow chart
9. To determine requirements in terms of personnel, equipment, and stock.

All of the above-mentioned activities are hardly applicable to the making of a cookie cutter by a seventh grade pupil; however, all of them can be taught as the pupil advances. Education in this area of industrial training is the responsibility of the Industrial Arts program. Therefore, the above steps should be learned on every project through repetition.

Planning as an Industrial Arts activity is a pupil function. It is present in all shops, even where special facilities have not been provided for its stimulation. If a project is worth doing, it is worth doing accurately and through an orderly procedure.

Purposing and planning require a like atmosphere. They are primarily paper processes preceding the *doing* or mechanical processes —executing. The area should be comfortable, well lighted, equipped with worktable space, featuring sketching and drawing equipment and such motivating material as catalogs, pictures, models, and book references.

Because of time limitations in junior high school grades, stress here should be placed upon the pupils' understanding of simple sketches and surface enrichment.

Drawing may become a primary activity for some pupils in the senior high school grades and, therefore, enough time should be devoted to teaching the simple drawing conventions and blueprint reading to all pupils to prepare them for this activity.

The planning area is the hub of all activities of the comprehensive general shop, no matter what subject areas are represented.

Facility in and comprehension of drawing will possibly require some practice in fundamentals. Sufficient facilities must be provided to give such fundamental drawing and interpretation practice to approximately one-fifth of the shop class at any one time. Such practice should not be the outmoded practice of drawing a series of plates, but should involve progressive steps in simple sketching, dimensioning, lettering, and three-view drawings. The articles used should be available as models seen and handled by the pupil. Struck[1] emphasizes the great value of *perceiving* in the creative learning process and declares that "petty accuracies" are of less importance than broad goals and self-satisfaction.

Specific Aims and Objectives

The planning area, or nerve center of the comprehensive general shop, emphasizes new and more meaningful benefits for pupils, which will:

1. Strengthen and increase the present motivating factors inherent in any Industrial Arts program, enabling the pupil to become more self-sufficient through the expression of his own ideas and by injecting his personality into his projects

2. Encourage and aid the pupil to conceive a particular project and to judge the feasibility of its manufacture in the areas of a particular comprehensive general shop

3. Encourage the pupil to search for new ideas in design, function, and construction

4. Encourage the pupil in the habit of planning work in advance in order that he does not haphazardly begin to make things which may not be completed because of unforeseen difficulties arising from the lack of adequate foresight gained through planning

5. Require deeper thought on the part of the pupil on the value of the object proposed.

6. Require the pupil to make reasonable sketches or drawings which he and others can interpret while the project is being made

7. Provide the means through which a pupil can learn to visualize completed projects from pictures and sketches

8. Teach the mathematics of and the necessity for accurate dimensioning of detailed drawings

9. Correlate the activities of all the areas in a comprehensive general shop

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[1] Struck, F. T., *Creative Teaching.* New York City, John Wiley and Sons, 1938, Chap. 23.

10. Provide the pupil with a means to learn to estimate the cost of projects and to develop a sense of time in project making

11. Provide an opportunity for the pupil to learn to use various catalogs, books, and indices

12. Teach the pupil how to buy such materials as lumber, plastics, and hardware, and where to buy these materials.

Occupations

The ability to propose and plan is indicative of the level of occupational attainment. Executive and engineering positions require the fullest measure of ability in planning. The skilled crafts demand more than average capacity in this regard, as compared with the ability needed at the laborer or operative level. Progress at school, at college, and in employment will be made in proportion to the ability of the person to purpose and plan.

2. Learning Units

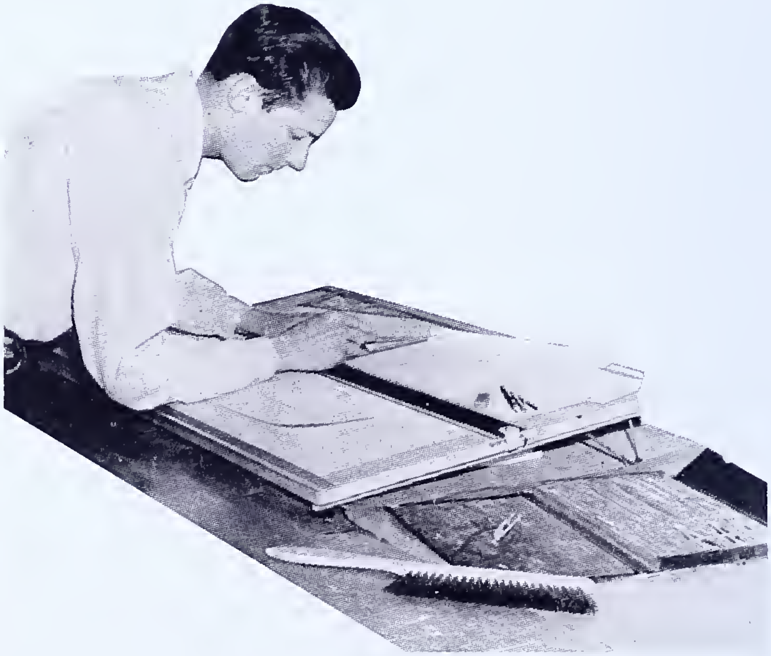
THINGS TO DO AND THINGS TO KNOW

The listings of suggested *Things to Do* and *Things to Know* which follow are helpful in establishing and maintaining an adequate planning area in a comprehensive general shop including perhaps four other shop areas.

From the following listings the general shop teacher may select those items which best fit his grade level, the time element, and other important considerations:

Things to Do	**Things to Know**
1. Use a catalog index	a. How to locate equipment and supplies in catalogs
2. Use book references and index	b. How to use shop references
3. Research for new ideas	c. Appropriateness of materials and processes
4. Visualize from pictures	d. Where to find project suggestions
5. Visualize from sketches	e. Nomenclature of a drawing or sketch
6. Make sketches of objects (enlarge sketches)	f. Principles of design
7. Dimension sketches	g. Reasons for scale drawings; measuring devices
8. Give proper proportion in sketches	h. Reasons for using proportions in drawings
9. Use drawing tools correctly (read a scale)	i. Technical terms and identities in drawing
10. Make a scale drawing—one-view	j. Fundamental drawing conventions
11. Make a scale drawing—two-view	k. Relations of views to drawings
12. Make a scale drawing—three-view	l. Reasons for more than one view
13. Make a tracing on tracing cloth	m. Reasons for tracing and for transferring designs
14. Make a blueprint	n. Processes for making multiple copies of drawings
15. Use inking tools	o. What drawing tools can do
16. Estimate costs of projects	p. Relation of cost to utility; fundamentals of arithmetic

17. Prepare a materials list	q. How to determine materials needed for a project
18. List sequences of work procedure	r. How to determine operational sequences
19. Estimate time requirements	s. How to utilize time well
20. Determine necessary helper aid	t. How to determine one-man and two-man jobs
21. List tools and machines required for making a project	u. What tools and machines are in the shop areas
22. Buy direct or order materials	v. Identification of material; how to make sensible purchases
23. Visit an industrial plant—engineering (planning) and drafting departments	w. How industry makes plans for manufacturing products



3. Organization of Instruction—

INSTRUCTIONAL MATERIAL AND DEVICES

The Planning area is the management and engineering center of the comprehensive general shop. As such it includes:

- Teacher headquarters
- Pupil information center
- Conference facility
- Library—book, magazine, and catalog reference room
- Drawing facility
- Estimating facility
- Visual aids center
- "Employment" and "unemployment" office

Teacher Headquarters

Providing an office for the Industrial Arts teacher has always been a problem. Today, with planning areas provided in most new Industrial Arts shops, the headquarters question is solved. The teacher's desk, chair, and file belong in the planning area.

The planning area is the nerve center of the shop's activity. Possibly twenty per cent of the pupils are working in the planning area on some phase of project engineering. Now more of the teacher's time can be shared with pupils at the desk and conference table than was possible when pupils rushed to their benches and clamored for something to make. The teacher needs the planning area to bring order out of chaos.

Pupil Information Center

Teachers should require that pupils take their problems and questions to the planning area where files, references, and other pupils are at hand as sources of information. Official office releases and news bulletins on school activities are posted. New equipment, supply items, new reference books, and project plans should be reported to all pupils on the bulletin board as they are made available.

The unsightly appearance and distracting influence of poorly displayed wall charts and commercial advertisements can be better handled by filing them for ready reference, or by providing for proper wall display space in the shop areas.

Conference Facility

The table and chairs of the planning area are used by the teacher when meeting one or more pupils to discuss shop and school affairs. The planning area is also a convenient place to meet visiting parents and graduates.

Pupils, too, should be encouraged to plan school projects cooperatively around the conference table and to discuss their parts in handling school affairs. The pupil shop management organization can be made more effective if the teacher will call the members into frequent conferences for further instruction or commendation.

A place to meet is a prerequisite.

Library and Reference Facility

The planning area is the proper place for reference and project books for both teacher and pupils. A sectional bookcase for proper display of books, and a letter-type file cabinet for publications or supplementary teacher aids are needed for orderly housekeeping.

A major effort should be made to carefully index and file every item of instructional material, and to show the pupils how to use an index system. A library table and chairs should be provided so that pupils will want to study reference materials and browse through project books and prints in search of new ideas. It is equally important that the teacher accept his responsibility in fully utilizing these facilities.

Drawing Facility

General education objectives include an ability to interpret drawings and blueprints. A review of the reference books in the bibliography of this supplementary bulletin will show the various needs for graphic interpretation in our daily lives. Mechanical drawing as a separate, unrelated, uncoordinated school subject is giving way to a coordinated activity handled by each shop teacher as an integral part of the experiences gained in each shop area.

Drawing is one of the activity areas in the general shop organization. It is housed in the planning area because it is a management and engineering function. It is separated from the shops to minimize dirt and distracting noise. It is located near reference materials, project books, and a study table because these items are supplementary aids.

In the comprehensive general shop, drawing is not taught as a course of study. The following procedure is suggestive:

Beginning classes (seventh grade) are assigned work on projects planned by the teacher, but five or six members of the class are motivated to start activities in the planning area. For example, one would browse for project ideas, others would redraw project plans, make up simple bills of material, make paper templates or project parts, find the cost of project parts, do lettering or tracing, or study blueprint reading.

Supplementary aids should be made available to get all of the above activities and perhaps others under way with a minimum of "over-the-shoulder" instruction.

As class progresses, pupils are rotated through all the activities—including the planning area. A few pupils who show an inclination and aptitude for the work may remain longer in the planning area for more difficult assignments on the drawing boards.

Advanced pupils in the higher grades will be encouraged to utilize the planning area in connection with every project—experiencing, browsing for ideas, making sketches and drawings, estimating bills of materials, finding costs, making work analyses, and finally, working on the project of their selection.

Professor John Friese of the Pennsylvania State College is noted for his statement: "Experiences in life do not come to us departmentalized." The philosophy embodied in this quotation guides the teacher in using the planning area as an integral part of the general shop program.

Estimating Facility

Careful estimation of costs before construction may mean the difference between success or failure in any enterprise. Industrial Arts pupils, through the medium of the planning area, are encouraged to put down on paper the facts and figures needed to plan their projects so that every part fits. This procedure prevents waste of materials because pupils know in advance that the ultimate cost is within their ability to pay. Time spent in estimating provides an opportunity to acquire a skill common to all American enterprises, whether it be a small item made for the home or a great industrial project. Through estimating the pupil will learn the importance of the "time element" in production.

Visual Aids Center

If the planning area cannot be darkened for film projection, another room should be available to the Industrial Arts teacher for projecting visual aids. The efficient teacher will accumulate a file of pictures, blueprints, photographs, drawings, charts, and clippings to supplement his teaching.

The visual aids make teaching more effective. Visual aids are carefully filed and indexed and made available to pupils as needed.

Although visual aids are thought of generally as being viewed by a group, they can be examined at leisure by an individual pupil. For example, clippings of suggested projects can be mounted on cardboard, for use in an opaque projector, and can also be viewed by individual pupils without the use of a projector or a darkened room. Likewise, slide films can be viewed by an individual through a small slide viewer equipped with its own light without the benefit of a darkened room.

"Employment" and "Unemployment" Office

Every pupil in the shop areas should be engaged in a purposeful activity. When his own project is completed, the pupil may use the planning area to seek further employment; or he may secure help from others on "two-man" jobs, such as gluing up a job or placing a heavy form in a printing press. Rather than interfere with the work continuity of others, he should go to the planning area for assistance. The bulletin board is used to post the need for volunteers on certain school projects.

Any pupils not purposefully engaged in the shop areas should be directed to the planning area to browse through references for project ideas, look for work assignments, or await the teacher for further instruction.

Use of Forms

The Pupils' Planning Sheets on pages 13 and 14 are suggestive to the teacher who will want to plan his form to meet his own shop conditions. Such forms may be mimeographed or printed to be readily available to pupils in the planning area.

It is expected that the teacher will check the pupils' plans carefully before they start on any project in any area of the shop. It is likely that many projects will of necessity be made in several areas of the shop. For example, in a comprehensive general shop where graphic arts and woodworking are units, a perpetual calendar can be made. The calendar holder would be made in the woodworking area, and the 12-month calendars would be printed in the graphic arts area. Pupils will conceive many projects which will include every area of the shop.

The back of the planning sheet can be used for a sketch or layout of the project. In some instances, the teacher will prefer plans drawn on paper of varying kinds—squared, isometric, or tracing paper.

The use of such forms will enable the pupil to plan intelligently, and will help him to include the cost of all items. Using a planning sheet to list all operations will also save pupil time.

SUGGESTED PUPILS' PLANNING SHEET—A

Name ....*Class* ..... *Date* ....

Name of Project ....*Source* ....

Indicate Areas in the Comprehensive General Shop, such as Woodworking, Plastics, Home Mechanics, Graphic Arts, where the project is to be made:

MATERIALS NEEDED

		Size	*Cost*	
Quantity	*Item*	*Length, Width, Thickness*	*Each*	*Total*
		x x x		
		x x x		
		x x x		

SPECIAL HARDWARE

			Cost	
Quantity	*Item*	*Size*	*Each*	*Total*

Finishing Supplies		Total Cost
No. of Coats	*Material*	Materials .... $________ Hardware .... $________ Finishing .... $________ Total .... $________

LIST OF OPERATIONS IN SEQUENCE

1.
2.
3.
4.
5.
6.

(Use other side for sketch or drawing of project)

SUGGESTED PUPILS' PLANNING SHEET—B

Project .... *Pupil's Name* ....

Area ....

MATERIALS					TOOLS and EQUIPMENT	
Quantity	*Identity*	*Size*	*Cost Per Unit*	*Total*	*List of tools and machines to be used*	*Teacher check and approval of each tool and machine*

LIST PROCEDURE OF OPERATIONS IN SEQUENCE

(Use Paper Supplied for the Purpose of Making Sketch or Drawing)

1.

2.

3.

4.

5.

6.

7.

8.

9.

10.

11.

12.

13.

Date Project was started .... Date Project was completed ....

Teacher Check and Approval .... Grade ....

Teacher Comments and Shop Difficulties ....

4. Instructional Aids

BOOKS, CATALOGS, FILMS

In a book of this kind it is impossible to list all of the instructional materials in the form of books, pamphlets, study guides, charts, etc. Many instructors may be using excellent instructional aids not included here since this listing is not exhaustive.

Certain instructional materials are listed, however, with author, publisher, address of publisher, and an annotation of the contents, so that the Industrial Arts teacher will know what phase of instruction is included in each reference.

BOOKS

Bartholomew, Roy A. and Orr, Francis, *Learning to Read Mechanical Drawings.* Peoria, Illinois, Charles A. Bennett Company, Inc., 1937, 48 pp. Paper $0.68.

A method for rapid and economical teaching of the fundamentals of mechanical drawing, using only the simplest equipment on the regular schoolroom desk. Provides sufficient information for reading blueprints and shop drawings, and affords the basis for training by means of sketches in orthographic, oblique, isometric, and perspective. Seventh and eighth grade levels.

Baysinger, Gerald and Silvius, G. Harold, *The Students' Planning Book.* Scranton 9, Pennsylvania, International Textbook Company, 1950, 64 pp. Paper $1.50.

Designed for industrial arts and vocational classes. Procedures for adequate planning of projects, selection of correct tools and materials, and observation of safety precautions. Suggests pupil-personnel program.

Berg, Edward and Kronquist, Emil F., *Mechanical Drawing Problems.* Peoria 3, Illinois, Charles A. Bennett Company, Inc., 1922, 197 pp. Cloth $1.96; Paper $1.76.

Each problem is selected from industry and the trades. Grouped for progressive learning in a standard two-year high school course. Wherever feasible, the system is based on teaching by example rather than by description or explanation. Very flexible choices offered; therefore, adapted to varying degrees of aptitude in a class.

Coover, Shriver L., *Workbook in Mechanical Drawing.* New York City, New York, McGraw-Hill Company, 1947, 201 pp. $1.40.

A functional workbook in mechanical drawing for beginning students. Presents projects and problems of general interest, suitable for the school or home workshop, rather than meaningless exercises or engineering drawing problems. Throughout, the material is geared to the needs and interests of beginners in mechanical drawing. Unit structure permits each student to progress at his own speed. A list of correlated motion pictures is included.

Crook, Thurman C., *Simplified Mechanical Drawing.* New York City, New York, McGraw-Hill Company, 1935, 174 pp. $2.20.

An easy-to-grasp introduction to mechanical drawing for the junior high school grades. Step-by-step approach, presenting considerable straight-line drawing before compass work. Eighty-eight drawing problems, all practical, and readily adaptable to shop projects. Lesson sheets face each drawing, offering information, suggestions for procedure, and questions.

Diamond, Thomas, *A Primer of Buleprint Reading.* Milwaukee 1, Wisconsin, Bruce Publishing Company, 1940, 70 pp. $0.60.

Provides well-prepared drills for teaching the beginner how to read working drawings. Excellent teaching suggestions.

Fleming, Joseph W., Barich, Dewye F., and Smith, L. C., *Applied Drawing and Sketching.* Chicago 37, Illinois, American Technical Society, 1950, 156 pp. Paper $2.00.

The salient feature of this book is its realistic application to the needs of everyday life. Today, drawings and sketches are an important part of communications in our highly industrialized society. This book supplies the basic knowledge necessary for the proper interpretation of such communications and also provides skill training that will greatly speed up progress in any subsequent courses in drafting. Does not require the use of drafting instruments.

French and Svensen, *Mechanical Drawing.* New York City, New York, McGraw-Hill Company, 1948, 437 pp. $2.80.

This revised and enlarged edition of French and Svensen's *Mechanical Drawing* retains all the well-liked features of the earlier editions, but offers many improvements and much new material. The text has been rewritten; most of the illustrations have been worked over or improved; and new chapters have been added on aircraft drawing, production illustration, and welding drawing. Many illustrations have been replaced and many new illustrations added, including movie-type illustrations. A large number of new problems have been introduced. Revisions and additions in the text keep the presentation up to latest standards in subject matter and pedagogy. A complete set of new Text-Films is provided for this edition.

Karch, R. Randolph, *Basic Lessons in Printing Layout.* Milwaukee, Wisconsin, Bruce Publishing Company, 1952, 140 pp. $1.96.

This book was written specifically to fill the need for a basic text on planning a graphic arts project at the elementary level. Keyed to the equipment in average graphic arts classes, the book is a simple presentation of the subject for beginners, aimed to acquaint them with the fundamentals of good printing design and layout. It contains many helps for pupil and teacher: 209 objective-type questions, tables for figuring when planning, 34 layout assignments, and 30 clipping assignments for students to bring to class.

Lightle, R. Paul, *Blueprint Reading and Sketching.* Bloomington, Illinois, McKnight and McKnight, 1950, 72 pp. Paper $0.80.

A course in blueprint reading written especially for the beginning student. The problems have been selected to give experience over a broad range of subject matter to the beginning junior or senior high school student. The text may be used as a separate short course preceding shop work, or to supplement the regular general drafting classwork. Twenty-four sketching problems; fifty-four problems in blueprint reading.

Ming, Frederick W., *Drafting Standards—Accepted and Proposed.* American Society of Mechanical Engineers and the American Welding Society, published by Higgins Ink Company, Brooklyn, New York.

Wilber, Gordon O., *Industrial Arts in General Education.* Scranton, Pennsylvania, International Textbook Company, 1948, 362 pp. $3.50.

Contents: The Purposes of General Education; The Relationship of Industrial Arts to General Education; Objectives of Industrial Arts; Analysis of Objectives; Selection of Subject Matter for Industrial Arts; Starting the Class; The Demonstration; Visual Aids in Industrial Arts; The Industrial Arts Project; Written Instructional Materials; The Shop Library and Planning Center; Personnel Organization; Industrial Arts and Public Relations; Community Resources; Records and Record Keeping; Shop Planning and Layouts; School Shop Equipment; Evaluating Results in Industrial Arts; Index.

Zipprich, A. E., *Freehand Drafting.* New York City 3, New York, D. Van Nostrand Company, 1935, 129 pp. $2.60.

There has been a shift in the teaching of drawing and draftings. More and more schools realize that many students who are going to work with machines do not need to become finished draftsmen. They need to know how to read blueprints and how to make freehand sketches from which expert draftsmen may make final drawings. On the other hand, every draftsman needs freehand drafting as a means of visualizing and as a constant convenience in his work. There is no getting away from this need for freehand drafting and this text teaches it thoroughly and with practical speed.

CATALOGS

Catalogs useful as reference in developing a bill of materials and/or a purchase order include those of:

Broadhead-Garrett Company, Cleveland, Ohio.

Montgomery Ward Company, Baltimore 32, Maryland.

Pease Woodwork Company, Cincinnati 23, Ohio.

Sears, Roebuck and Company, Chicago, Illinois.

PROJECT REFERENCES

See the supplementary bulletins (listing on cover page) representing the areas included in a given comprehensive general shop.

FILM SOURCES AND FILM TITLES

The following films and filmstrips are available at State Teachers Colleges in Pennsylvania:

Films:

PRI— 1 BPR, "Behind the Shop Drawing"

PRI— 4 BPR, "Reading a Three-View Drawing"

PRI— 6 BPR, "Visualizing an Object"

PRG—1D, "Draftsman, The"

Filmstrips:

PRI—FS—1D, "Geometric Construction" Part I

PRI—FS—2D, "Geometric Construction" Part II

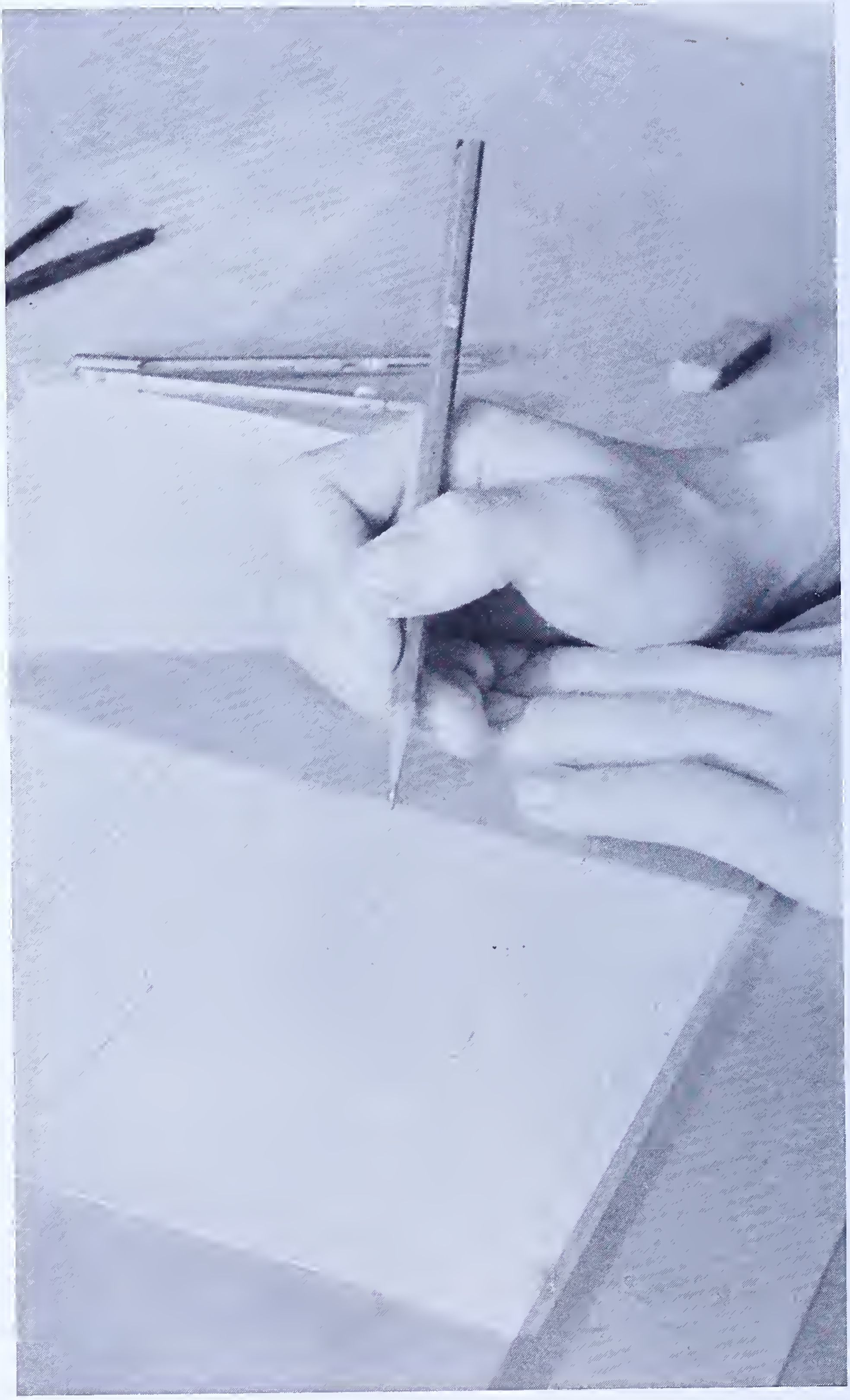
PRI—FS—3D, "Develop an Intersection, How to" Part I

PRI—FS—4D, "Develop an Intersection, How to" Part II

PRI—FS—5D, "Mechanical Drawing and Drafting"

PRA—FS-52 ME, "Mechanical Drawing"

A list of Sources of Films, Filmstrips, and Slides will be found on page 90 in Bulletin 331, *Industrial Arts in Pennsylvania,* published by the Department of Public Instruction, 1951. Many of the large industrial and automobile corporations have films available to schools. It would be desirable to secure catalogs from each one.



5. Equipment and Supplies

EQUIPMENT AND SUPPLY LISTS

In keeping with the general philosophy of Industrial Arts education, and the specific objectives of the planning area, a suggested list of equipment and supplies follows.

Some items may be made in the shop areas, particularly if the general shop features woodworking.

EQUIPMENT LIST[1]

Quantity	*Description*	*Price*
1	Basket, waste, steel, 15″ diameter, 18″ high	$1.65
1	Book and catalog cabinet, 4 open shelves, 36″ x 18″ x 78″ high	27.25
1	Bulletin board, cork type, 36″ x 60″	16.50
1	Cabinet, storage, for films, projector, charts and visual aids, steel, locked, 26″ x 18″ x 78″ high	46.10
1	Case, display, for suggested projects, glazed doors, shelves adjustable, 42″ x 14¾″ x 72″ high	75.55
1	Chalk board, with trough, fastened to wall, 3½′ x 6′	16.90
	Chairs:	
5	Library type, with arms, oak, $10.65 each	53.25
1	Teacher's, swivel, rigid oak arms	16.00
1	Desk, teacher's, single pedestal, oak, 42″ x 30″ top	51.30
20	Drawing boards, white pine, 20″ x 26″, $2.82 each	56.40
5 sets	Drawing instruments, with 6½″ compass, friction divider, pen attachment, extension point, ruling pen, box of leads and points, $14.20 each	71.00
1	File, letter size, 3-drawer, locked	47.15
1	Magazine rack[2]	—
6	Rulers, 18″ brass-edged, 1/16ths, 28 cents each	1.68
1	Shears, 10″	4.13
5	Scales, triangular, 12″, graduated 3/32, 3/16, ⅛, ¼, ⅜, ½, ¾, 1, 1½ and 3 inches to the foot, 50 cents each	2.50

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[1] Prices are those of 1952, and therefore approximate.
[2] To be made in the school woodworking shop.

Quantity	*Description*	*Price*
5	Stools for drawing tables, steel, $6.60 each	33.00
1	Table, conference type, oak, 30″ x 72″	60.00
5	Tables, drawing, adjustable top, four lockers, opening for drawing boards, steel, 45½″ x 26″, $75.00 each	375.00
5	Triangles, drawing, 30°-60°, 45°-90°, 8″, 32 cents each	1.60
5	T-squares, transparent edge, 24″, $2.20 each	11.00
	Total	$967.96

INITIAL SUPPLY LIST[1]

Quantity	*Description*	*Price*
12 pc.	Art gum, 1″ x 1″ x 1″	$.52
5	Curves, French, 50 cents each	2.50
1 bx.	Erasers, pencil, Ruby	2.05
5 btl.	Ink, India, drawing, ¾ oz., 30 cents each	1.50
	Paper:	
1 rm.	Drawing, manila, 18″ x 24″	5.15
1 rm.	Cross section, white, ¼″ squares, 12″ x 18″	4.36
1 rm.	Tracing, 12″ x 18″	7.26
36	Pencils, 2H drawing, 59 cents doz.	1.77
10 yds.	Tape, Scotch drafting, ¾″ wide	.39
	Total	$25.50

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[1] Prices are those of 1952, and therefore approximate.

6. Suggested Layouts

FOR THE PLANNING AREA

THE TEACHER HEADQUARTERS is the planning center of the shop activity. It may be only a desk, chair, and filing cabinet. But limiting the facility in this way restricts pupil participation.

The planning area should be well equipped for its purpose, be attractive, and its environment should stimulate the pupils' mental processes.

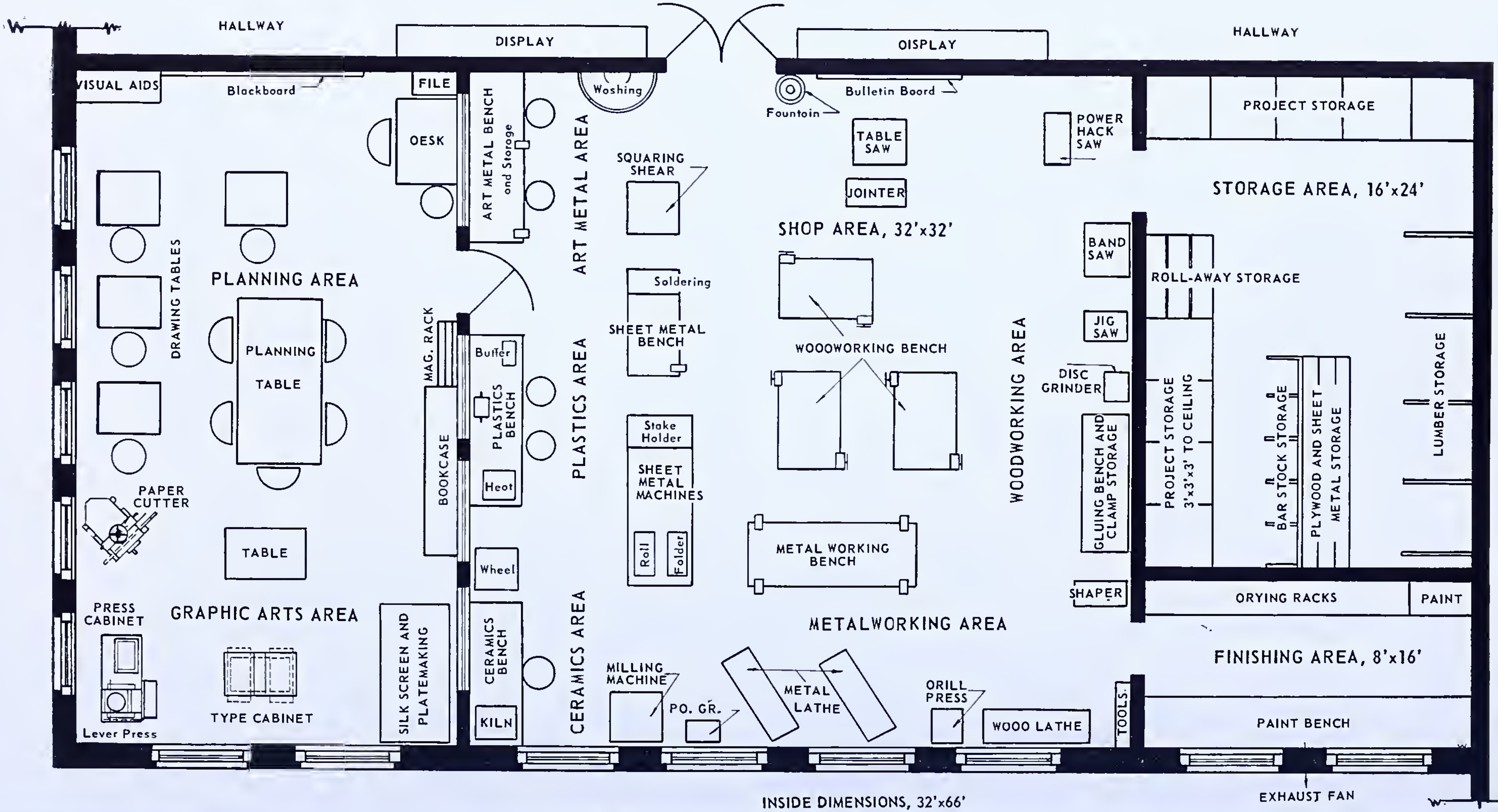
The area should be enclosed by windowed partitions and passage door, so the teacher will have visual control of all activities regardless of his location as he observes and teaches among the groups.

Proper lighting calls for about 50-foot candles of illumination at a 30-inch table height. Fluorescent fixtures have proved to be satisfactory. A unit ventilator or ventilators, as well as radiators, should be considered. Hinging one or more of the partition windows will also aid ventilation.

Selection of the equipment in the planning area will be influenced by the activities in the comprehensive general shop. A review of the preceding pages will stimulate thought for this selection. The following list of articles of furniture may be used as a guide for selection:

Drawing tables for planning activities
Conference table
Bookcases for reference material and books
Teacher's desk, chair, and filing cabinet
Filing cabinet for references and plans
Chalk board for teacher's use
Mock-up board (where feasible)
Visual aids cabinet
Magazine rack
Display case with glass doors for models of projects
Bulletin board for announcements, concerning newly installed machinery, project ideas, etc.

When placing equipment and furniture consideration must be given to lighting, accessibility, pupil traffic, good housekeeping, and pupil accommodation. Six typical layouts of planning areas which may be used as guides follow:



Comprehensive General Shop Layout—Plan A
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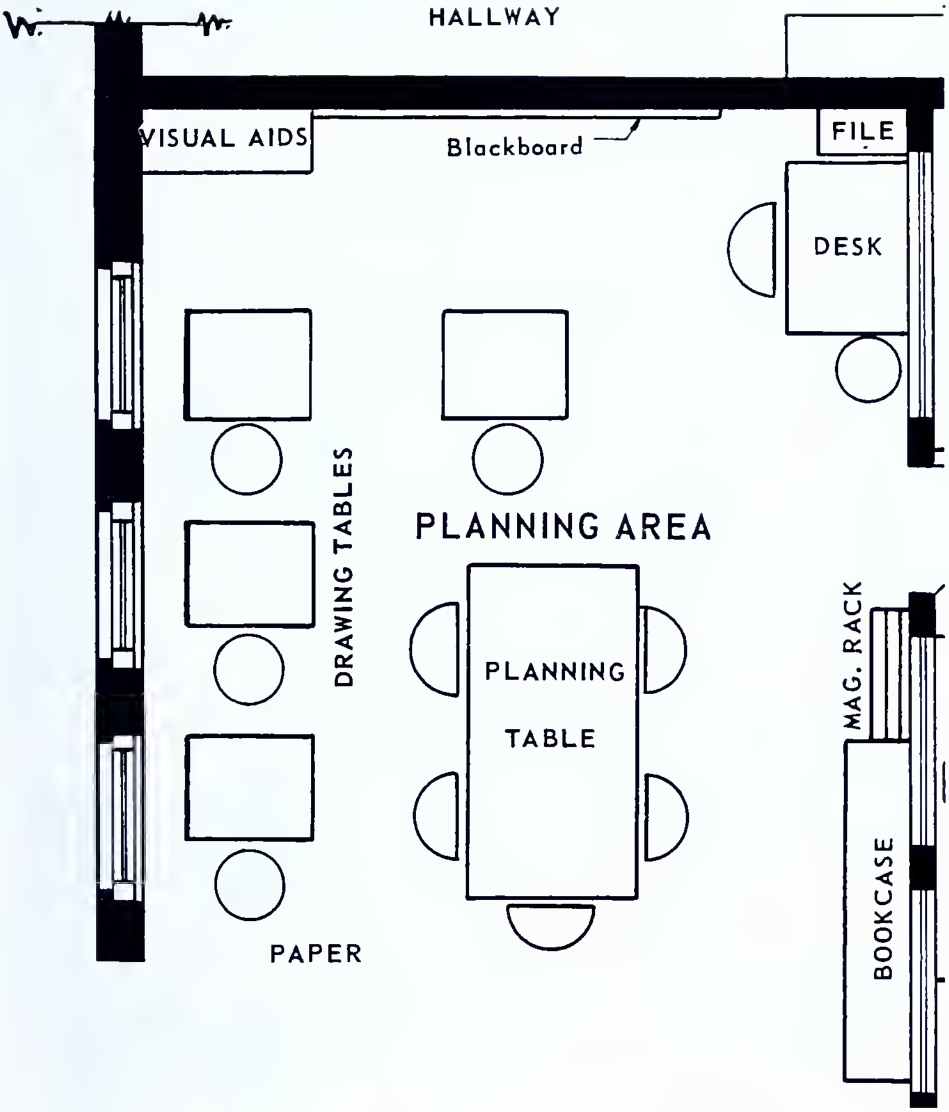


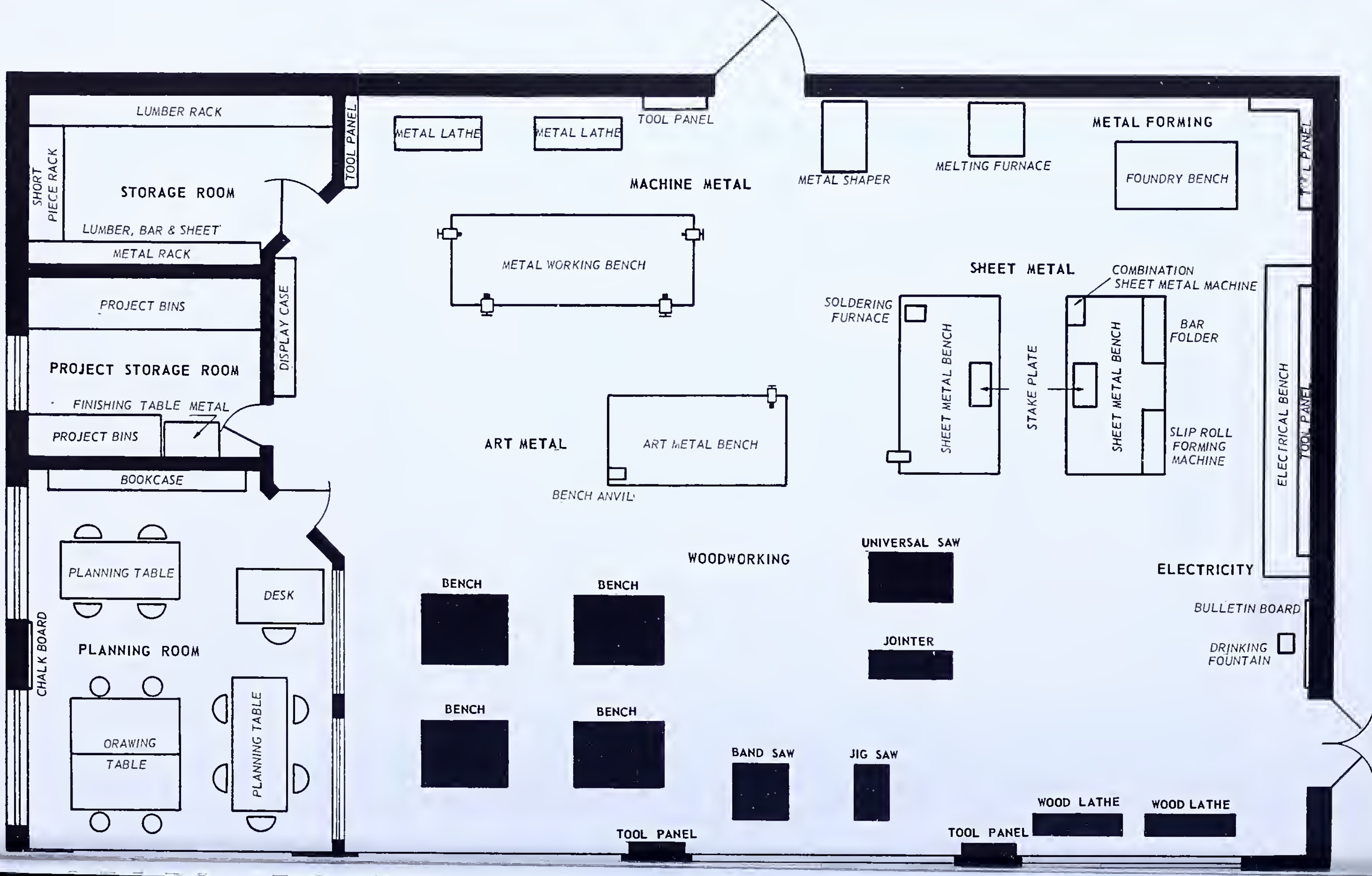
Plan A

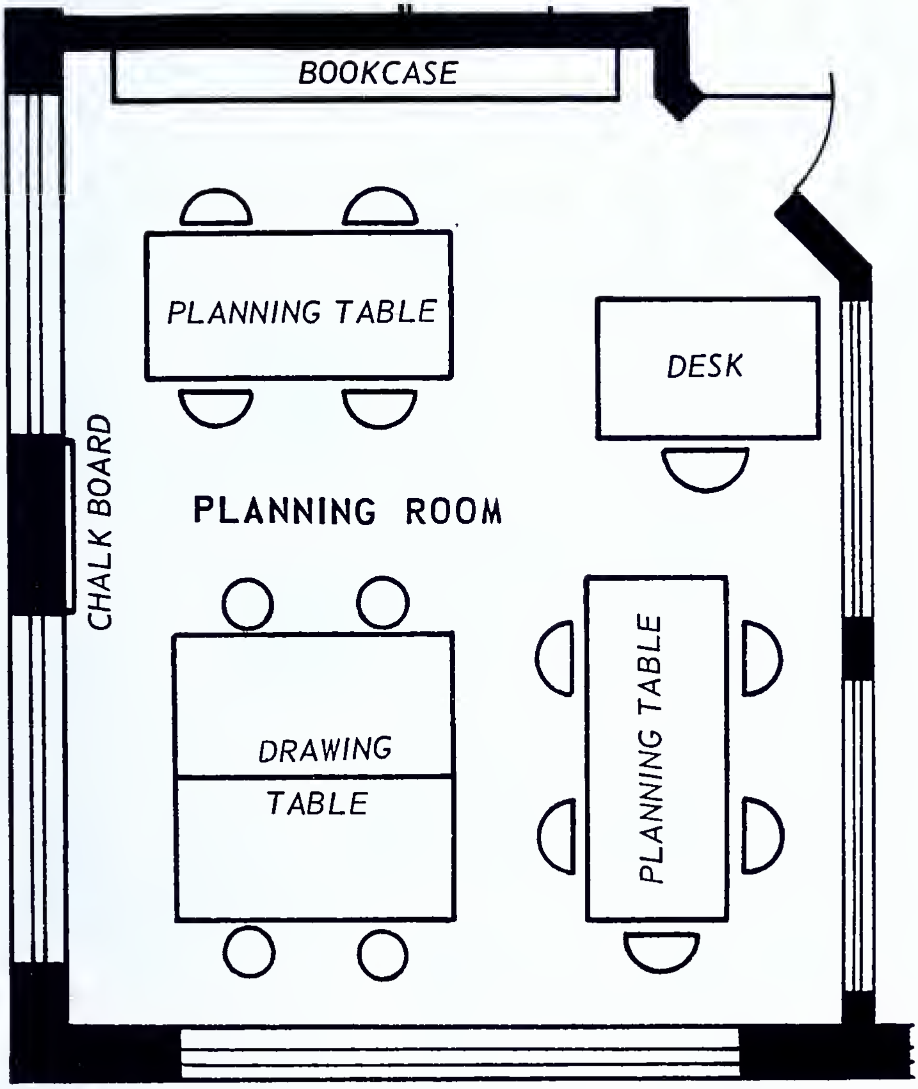
The entire comprehensive general shop layout appears on page 22. An enlargement of the planning area, at the left of the layout on page 22 is shown above.

Plan A illustrates a shop layout which incorporates an activity of the comprehensive general shop (graphic arts) in the planning area. A slight rearrangement of equipment would allow planning and graphic arts to be separated by a glass partition.

Featured in this plan are four individual drawing tables, a large planning table, bookcase, magazine rack, cabinet for visual aids, blackboard, teacher's desk, and file.

This planning area services the following activities: graphic arts, art metal, plastics, ceramics, woodworking, and metalworking.

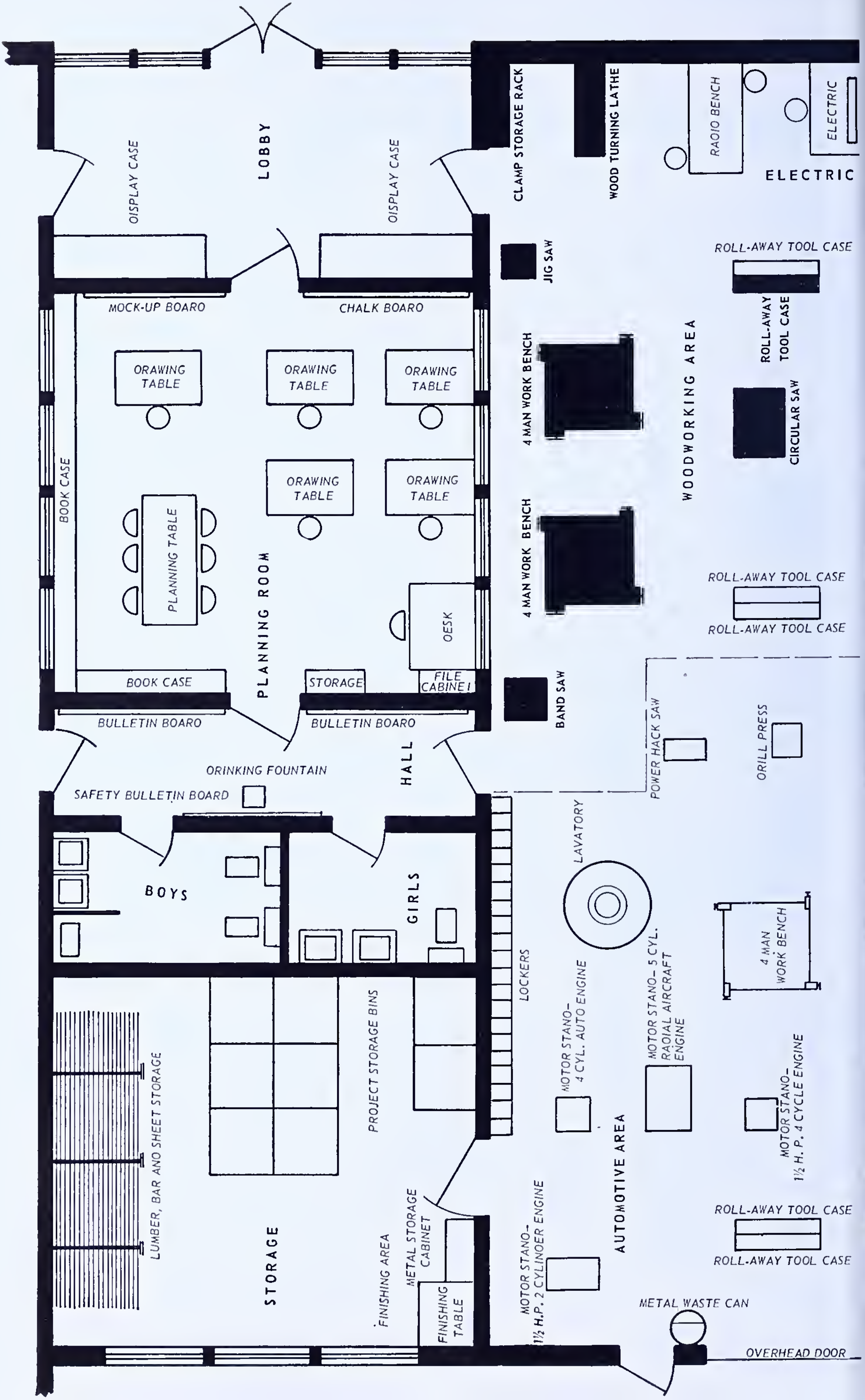

LUMBER RACK
SHORT PIECE RACK
STORAGE ROOM
LUMBER, BAR & SHEET
METAL RACK
TOOL PANEL
PROJECT BINS
DISPLAY CASE
PROJECT STORAGE ROOM
FINISHING TABLE
METAL
PROJECT BINS
BOOKCASE
PLANNING TABLE
DESK
PLANNING ROOM
CHALK BOARD
DRAWING TABLE
PLANNING TABLE
METAL LATHE
METAL LATHE
TOOL PANEL
MACHINE METAL
METAL WORKING BENCH
METAL SHAPER
MELTING FURNACE
METAL FORMING
FOUNDRY BENCH
TOOL PANEL
SHEET METAL
COMBINATION SHEET METAL MACHINE
SOLDERING FURNACE
SHEET METAL BENCH
STAKE PLATE
SHEET METAL BENCH
BAR FOLDER
SLIP ROLL FORMING MACHINE
ELECTRICAL BENCH
TOOL PANEL
ART METAL
ART METAL BENCH
BENCH ANVIL
WOODWORKING
UNIVERSAL SAW
ELECTRICITY
BULLETIN BOARD
DRINKING FOUNTAIN
BENCH
BENCH
JOINTER
BENCH
BENCH
BAND SAW
JIG SAW
WOOD LATHE
WOOD LATHE
TOOL PANEL
TOOL PANEL

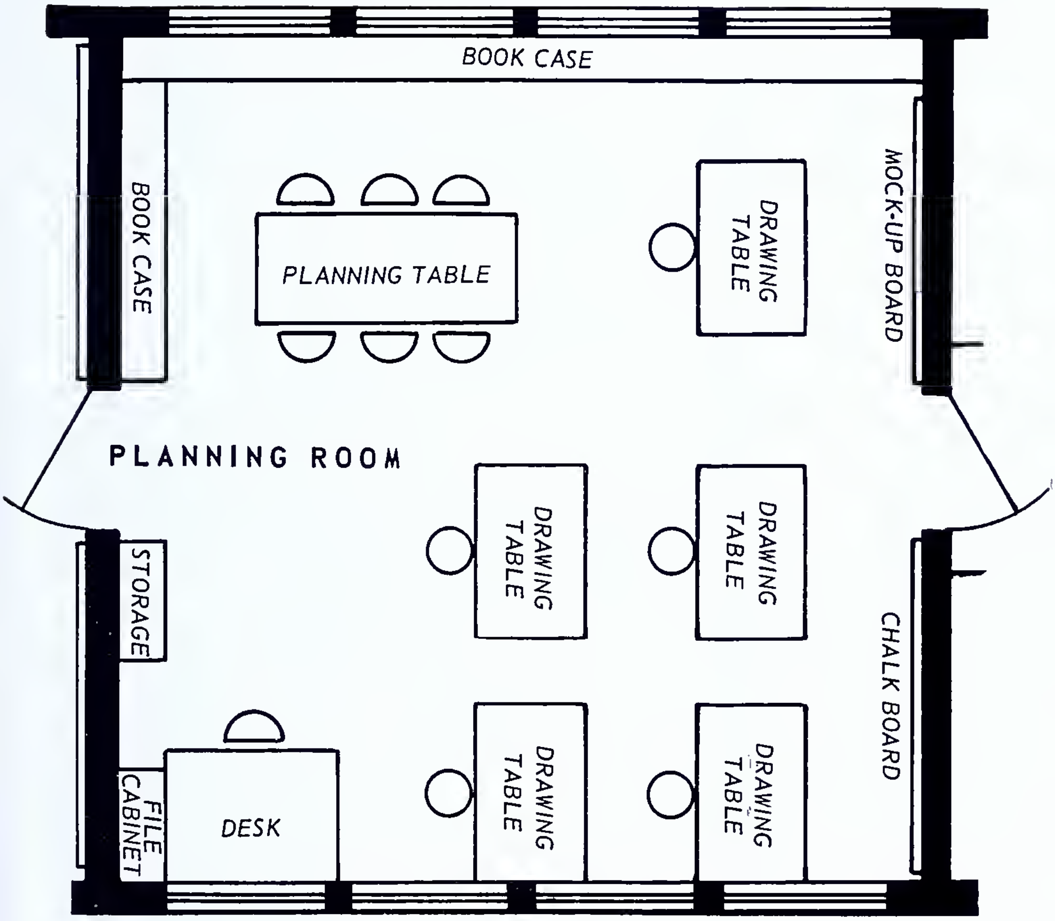


Plan B

The entire comprehensive general shop layout appears on page 24. The planning area, at the lower left of the plan on page 24, is enlarged above.

Plan B illustrates a typical planning area to service the following activities: art metal, woodworking, machine metal, sheet metal, metal forming, and electricity. Placed in a corner of the shop, the equipment in this planning area includes two double drawing tables, two large planning tables for group meetings and discussions, teacher's desk and chair, chalk board, and bookcases.

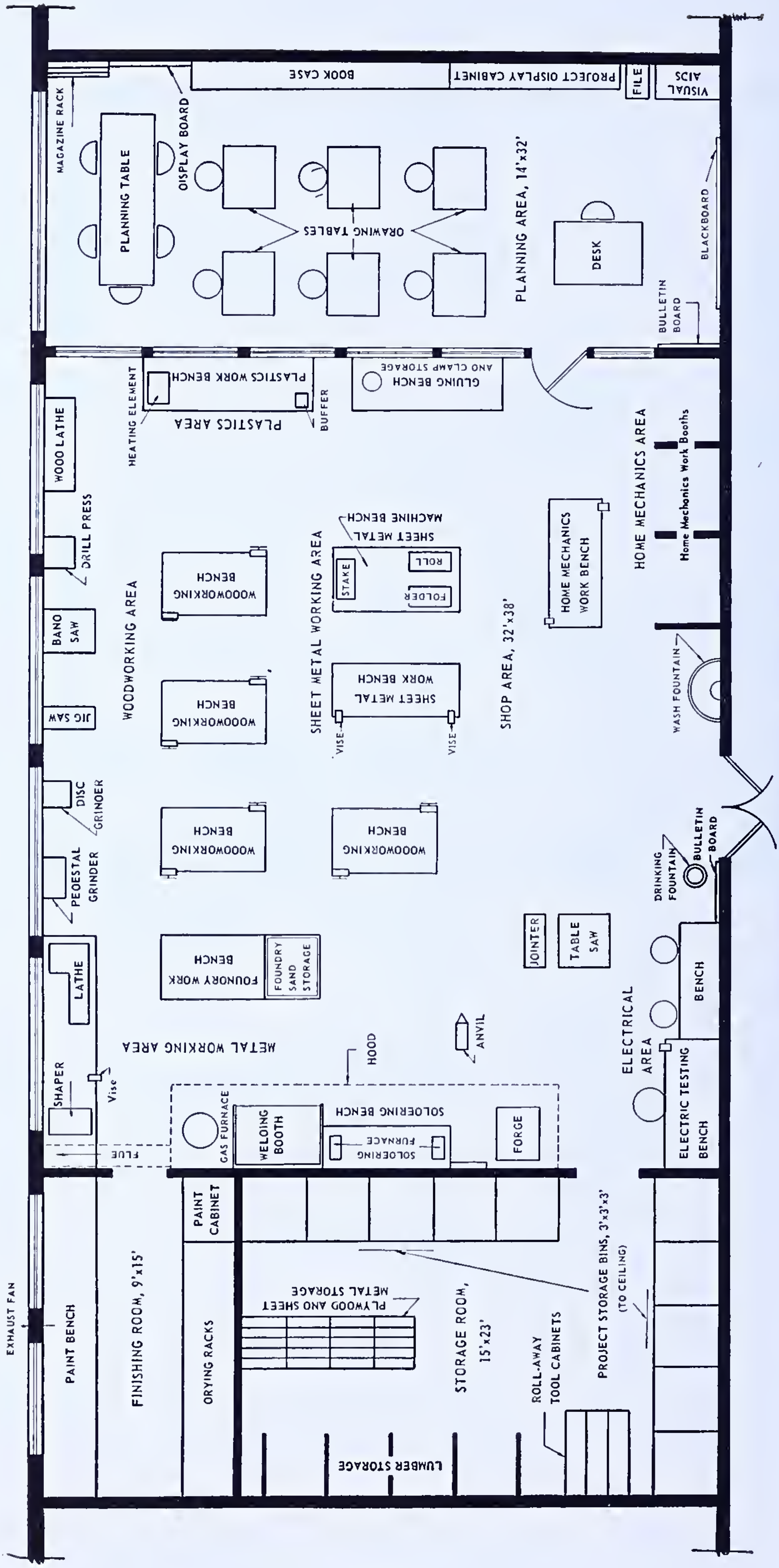

LOBBY
DISPLAY CASE
DISPLAY CASE
CLAMP STORAGE RACK
WOOD TURNING LATHE
RADIO BENCH
ELECTRIC
ELECTRIC
JIG SAW
ROLL-AWAY TOOL CASE
ROLL-AWAY TOOL CASE
MOCK-UP BOARD
CHALK BOARD
DRAWING TABLE
DRAWING TABLE
DRAWING TABLE
DRAWING TABLE
DRAWING TABLE
BOOK CASE
PLANNING TABLE
PLANNING ROOM
DESK
BOOK CASE
STORAGE
FILE CABINET
BULLETIN BOARD
BULLETIN BOARD
4 MAN WORK BENCH
4 MAN WORK BENCH
WOODWORKING AREA
CIRCULAR SAW
ROLL-AWAY TOOL CASE
ROLL-AWAY TOOL CASE
BAND SAW
POWER HACK SAW
DRILL PRESS
HALL
DRINKING FOUNTAIN
SAFETY BULLETIN BOARD
BOYS
GIRLS
LAVATORY
LOCKERS
4 MAN WORK BENCH
PROJECT STORAGE BINS
LUMBER, BAR AND SHEET STORAGE
MOTOR STAND– 4 CYL. AUTO ENGINE
MOTOR STAND– 5 CYL. RADIAL AIRCRAFT ENGINE
MOTOR STAND– 1½ H. P. 4 CYCLE ENGINE
AUTOMOTIVE AREA
STORAGE
FINISHING AREA
METAL STORAGE CABINET
FINISHING TABLE
MOTOR STAND– 1½ H.P. 2 CYLINDER ENGINE
ROLL-AWAY TOOL CASE
ROLL-AWAY TOOL CASE
METAL WASTE CAN
OVERHEAD DOOR



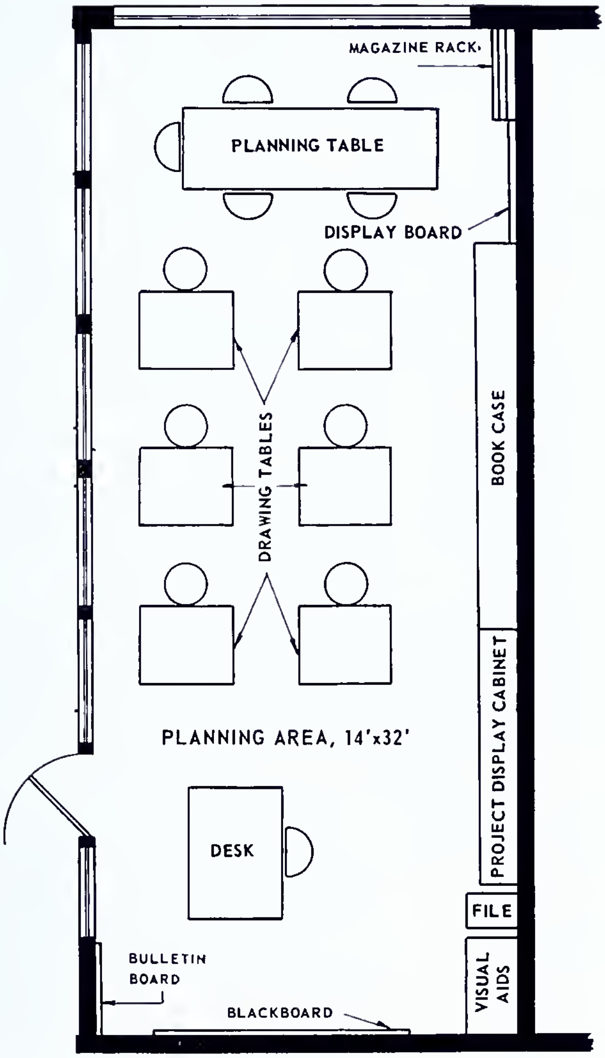
Plan C

The comprehensive general shop layout appears in part on page 26. The planning area, above and right of center of the plan on page 26, services the following activities: automotive, metal forming, sheet metal, metal machining, woodworking, and electricity.

Plan C illustrates one way to arrange the following equipment: large planning table for use for group discussions or individual study; five individual drawing tables; teacher's desk, chair, and filing cabinet; bookcases, mock-up board, and chalk board.



Comprehensive General Shop Layout—Plan D

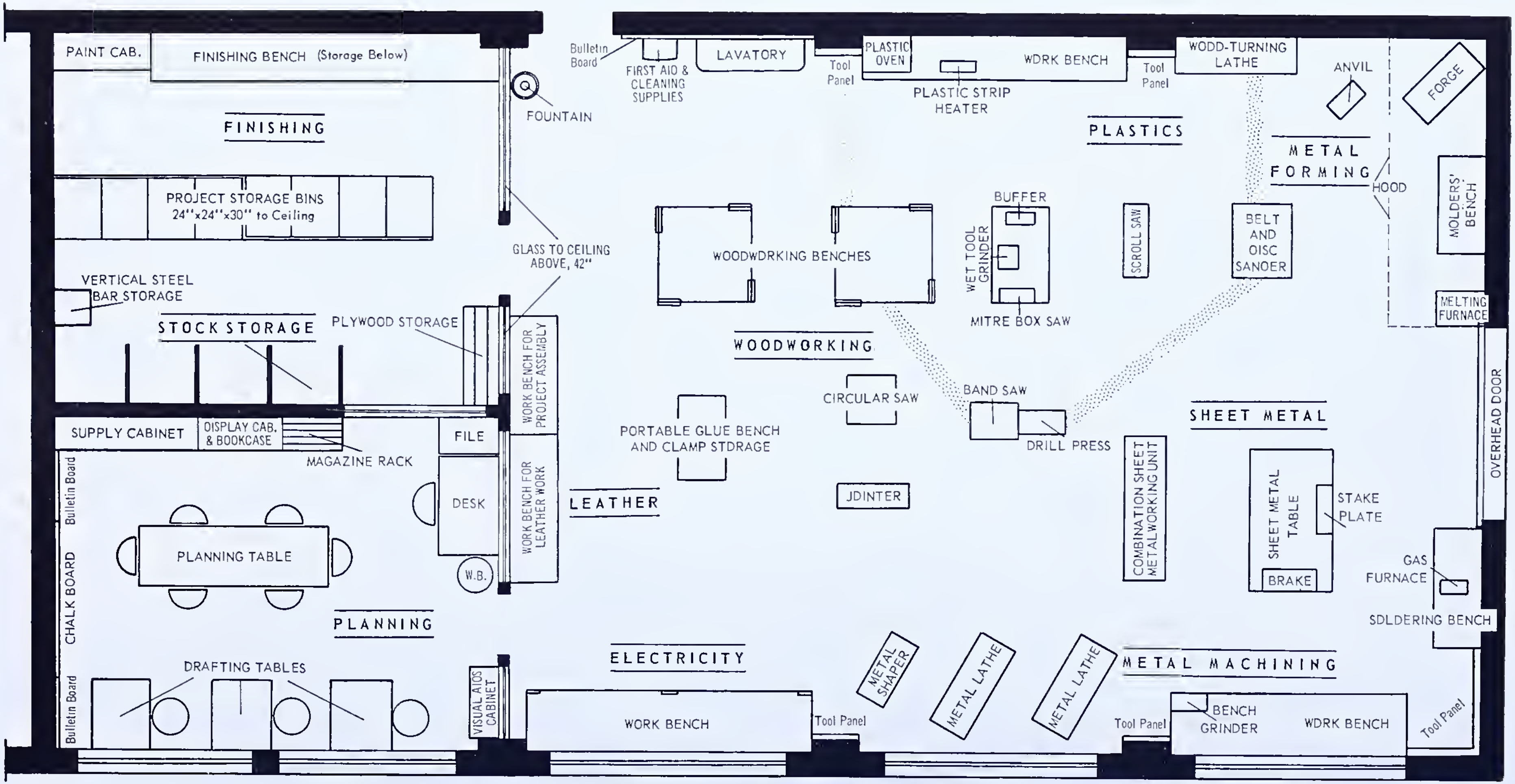


Plan D

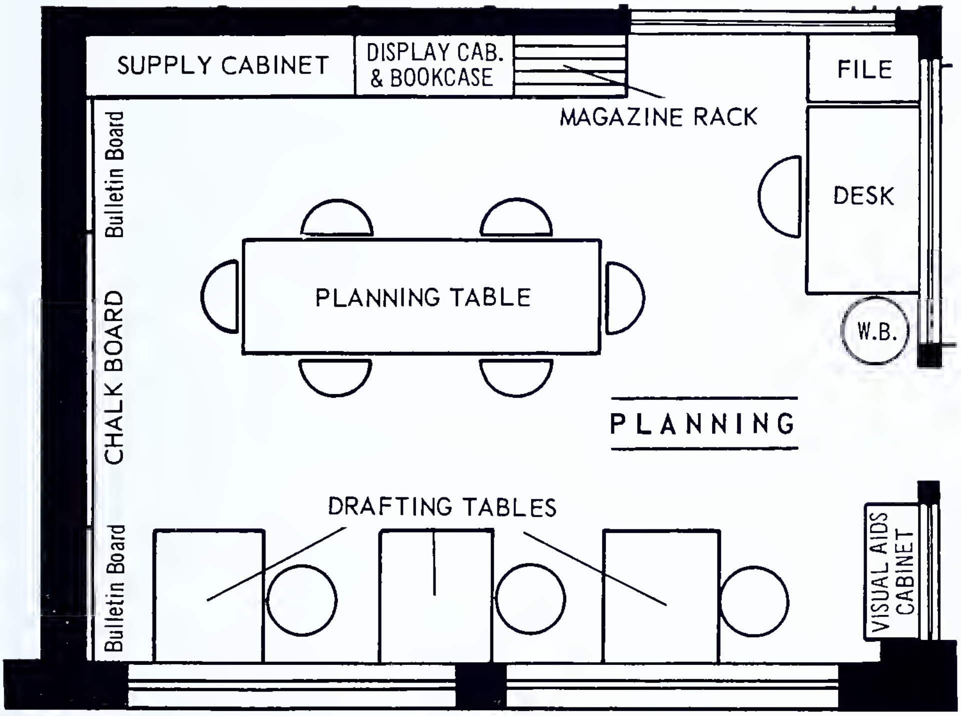
The entire comprehensive general shop layout appears on page 28. The planning area, at the right of the plan on page 28, is enlarged above.

Plan D illustrates a shop layout which incorporates such various activities common in a plan featuring home mechanics as: metal machining, metal forming, electricity, woodworking, plastics, and sheetmetal.

Featured in this plan are a magazine rack, planning table for conferences, display board, six drawing tables, bookcase, project display cabinet, visual aids cabinet, blackboard, bulletin board, and teacher's desk and chair.



Comprehensive General Shop Layout—Plan E

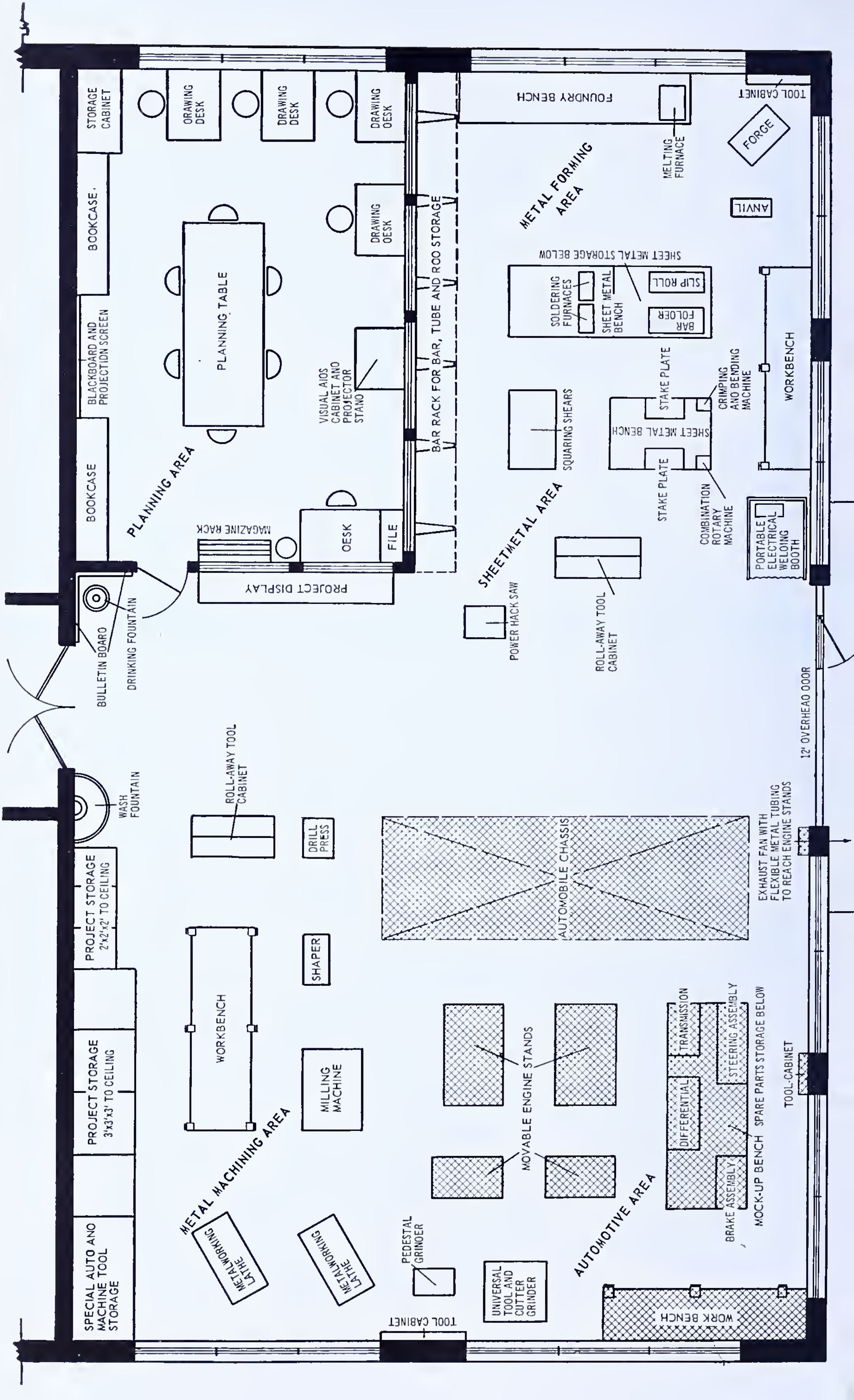


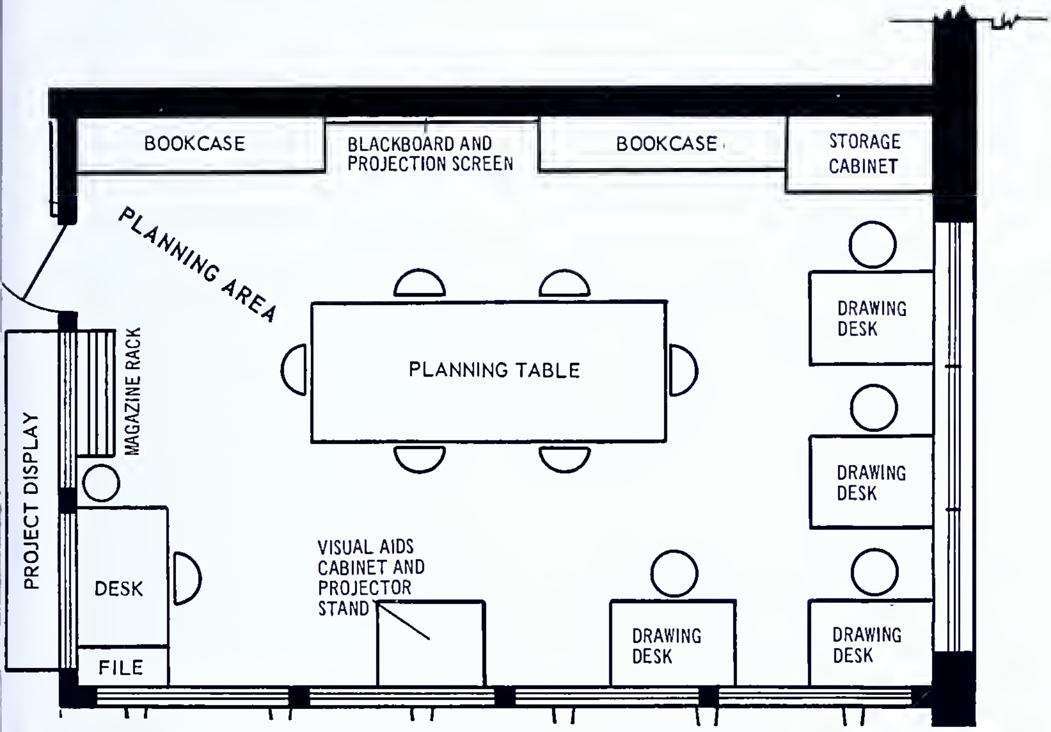
Plan E

The entire comprehensive general shop layout appears on page 30. The planning area, lower left of the plan on page 30, is enlarged above.

Plan E illustrates a well-equipped planning area which includes the following equipment: supply cabinets and bookcases, cabinet to display projects, magazine rack, teacher's desk, chair, and filing cabinet, visual aids cabinet, three drafting tables, large planning table also used for conferences, bulletin boards, and chalk board.

This planning area services the following activities: plastics, woodworking, leather, electricity, metal forming, sheet metal, and metal machining.


PLANNING AREA
STORAGE CABINET
DRAWING DESK
DRAWING DESK
DRAWING DESK
DRAWING DESK
BOOKCASE
PLANNING TABLE
BLACKBOARD AND PROJECTION SCREEN
BOOKCASE
VISUAL AIDS CABINET AND PROJECTOR STAND
DESK
FILE
MAGAZINE RACK
PROJECT DISPLAY
BULLETIN BOARD
DRINKING FOUNTAIN
BAR RACK FOR BAR, TUBE AND ROD STORAGE
METAL FORMING AREA
FOUNDRY BENCH
MELTING FURNACE
TOOL CABINET
FORGE
ANVIL
SHEET METAL STORAGE BELOW
SOLDERING FURNACES
SHEET METAL BENCH
SLIP ROLL
BAR FOLDER
WORKBENCH
SHEETMETAL AREA
SQUARING SHEARS
STAKE PLATE
SHEET METAL BENCH
STAKE PLATE
CRIMPING AND BENDING MACHINE
COMBINATION ROTARY MACHINE
PORTABLE ELECTRICAL WELDING BOOTH
POWER HACK SAW
ROLL-AWAY TOOL CABINET
12' OVERHEAD DOOR
WASH FOUNTAIN
ROLL-AWAY TOOL CABINET
DRILL PRESS
AUTOMOBILE CHASSIS
EXHAUST FAN WITH FLEXIBLE METAL TUBING TO REACH ENGINE STANDS
PROJECT STORAGE 2'x2'x2' TO CEILING
SHAPER
WORKBENCH
PROJECT STORAGE 3'x3'x3' TO CEILING
MILLING MACHINE
MOVABLE ENGINE STANDS
TRANSMISSION
STEERING ASSEMBLY
DIFFERENTIAL
BRAKE ASSEMBLY
SPARE PARTS STORAGE BELOW
MOCK-UP BENCH
TOOL-CABINET
METAL MACHINING AREA
AUTOMOTIVE AREA
SPECIAL AUTO AND MACHINE TOOL STORAGE
METALWORKING LATHE
METALWORKING LATHE
PEDESTAL GRINDER
UNIVERSAL TOOL AND CUTTER GRINDER
TOOL CABINET
WORK BENCH



Plan F

The entire comprehensive general shop layout appears on page 32. The planning area, upper right of the plan shown on page 32, is enlarged above.

This plan services the following areas of instruction: automotive, metal machining, sheet metal, and metal forming.

Furniture in this planning area includes two bookcases, blackboard and projection screen, storage cabinet, four drawing tables, a large planning table, visual aids cabinet and projector stand combination, magazine rack, and teacher's desk, chair, filing cabinet, and magazine rack.

Appendix

The following article, entitled "Student Planning—a Teacher Responsibility and a Student Activity," appeared in the October, 1952 issue of *Industrial Arts and Vocational Education.* It is perhaps the first published article dealing so thoroughly with Planning, a new Industrial Arts activity. Permission has been received from the author and publisher to include it here.

STUDENT PLANNING—
A TEACHER RESPONSIBILITY AND A STUDENT ACTIVITY

By Arthur C. Wenzel, *Dean of Men*
STATE TEACHERS COLLEGE, SHIPPENSBURG, PA.

Student planning is a "method of approach" for the construction of a project. It is an activity which should be a vital part of every industrial-arts situation. The teacher *must* first understand this method which will be successful if he is interested in teaching students how to *think* rather than how to *imitate.* Many teachers will not attempt to provide for student planning because they resist change to something they do not understand, and then it might take too much time. Any new activity is time consuming until it becomes thoroughly organized.

Student planning has been neglected and kept out of many industrial-arts programs much too long. A great number of intelligent and progressive teachers have become cognizant of the importance of this activity and have realized that it is a daily occurrence in our everyday living.

The teacher should be the motivating factor in this planning activity. The responsibility for planning is not assumed wholly by the student. Therefore it is necessary to set up some very definite teacher *responsibilities:*

1. Provide for individual needs, interests, and abilities. This identifies itself partially with Morrison's first principle of his unit plan

which is *exploration;* that is to discover the apperceptive base of the class. Then too the teacher must consider the needs which will lead to an interest.

2. Provide tools, materials, supplies and equipment.
3. Provide instructional materials for wise planning.
4. Provide source materials for wise planning.
5. Provide *planning area* for students. Here Wilber states:

> Emphasis on planning as an important function of industrial arts focuses attention on the need for a place to carry on this activity. Experience seems to indicate that better results are obtained from planning, and that it is easier to encourage students to plan, when some definite area is set aside and properly equipped and organized for this work.[1]

The student should next be considered in terms of objectives for planning which is a functional educative process dynamic in every aspect of daily living. Planning objectives identify and lend themselves to the objectives of industrial arts as well as general education. Crull states this objective: "To meet each child on the level of his particular abilities and interests and give him opportunities in accordance with his needs."[2] Here it will be necessary to set forth some *objectives for planning.*

1. Learn to accept a problem, plan and organize for it, progress in it, and finally complete it.
2. Develop systematic procedure for obtaining information needed for specific problems.
3. Be able to make an understandable sketch or working drawing.
4. Develop an appreciation for good design and construction.
5. Be able to select suitable materials for a particular project.
6. Develop a *time sense* for projects.
7. Develop tactfulness in seeking information.

These objectives are but means of progress for the student; his activities and experiences are but steps in progress. In student progress there is student growth which will contribute to the end objectives of *general education.*

A guide for *planning* should next be provided for the student and the necessary information for its completion. The student will do a better job if he plans his scheme of approach for the construction of his project. The student plan sheet is written or completed by the student, not by the teacher. This gives the student a better understanding of it. The student surely can interpret his written instructions. [A form which may serve as a guide for the content of a plan sheet appears on pages 39-40.—*Ed.*] The plan sheet should include the following items:

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[1] WILBER, G. O., *Industrial Arts in General Education,* International Textbook Co., 1948, p. 181.

[2] CRULL, H. D., "A Community Plans Its Program for the Future," *The Nation's Schools,* Vol. 31, No. 5, May, 1943, p. 41.

1. *Procedure or how to make my project.* Here the steps should be listed in a plain and simple manner. The information need not be detailed or complicated. Remember, this is student made and student understood. There will be a greater interest in its fulfillment by the student. It will above all stimulate thinking on the part of the student and the instructor.

2. *Operations I need to know.* By listing the operations necessary for the construction of the project the student can readily check those operations which are new to him. The instructor can easily notice the operations which need to be demonstrated. This will prevent any overlapping and over demonstration which is often the case in some situations. This will also show the differences in experience.

3. *Tools and equipment I expect to use.* This is necessary because the student can check for himself and look at the tool panel and about the shop to see if everything is available. If any tools are not available it may be reported to the instructor. This may help the instructor in ordering new tools for the shop. Sometimes students have ideas which are much worth while and should be recognized.

4. *Safety precautions I must observe.* This is very important because we want to be sure the student is *safety conscious.* Prevention is the best cure. It will be necessary for him to work safely at all times. The sudent should list safety rules which apply to his particular project.

5. *Materials for my project.* This will help the student become material conscious as well as *cost* conscious. A catalog may be provided to check the current prices for various materials. This will very definitely make the student a better consumer of materials. Materials not on hand can be ordered.

6. *Estimated time and actual time.* The student should become time conscious and therefore should have the opportunity to decide *how long it will take him to finish his project.* Ultimately then unfinished projects will be the exception rather than the rule. Actual

time should be recorded so that the student can check it against the estimated time.

7. *Suggestions by the instructor.* This is to serve as a check for the planning items listed by the student. The instructor should suggest changes in the selection of materials, etc., whenever it will make for better results in the construction of a project.

8. *Source information.* The student should list books, magazines, etc., from which ideas were taken for the project. A wealth of source information should be available to the student to help him *think and plan* intelligently.

9. *Sketch or working drawing.* The graphic representation should be a working means for the construction of the project. The sketch should be understood by the instructor as well as the student. The sketch need not be instrument drawn. The beginner should use a straightedge and pencil.

10. *The project.* The student should answer some basic questions for the selection of a project: (a) Am I interested in making a project? (b) Do we have the materials and tools needed for the construction of my project? (c) Will it serve a need in my home? (d) Will I have enough money to pay for my project? (e) Will the construction of it challenge my ability? The project may be one suggested by the instructor or one chosen by the student.

Planning effectiveness will increase with the experience and growth of the student. Planning is a student activity as well as a teacher responsibility. The plan sheet should initiate student interest and thinking as well as provide for his needs, ability, and progress. If planning for a project is new to the student the teacher will have to start out by planning *with the entire class* and actually teach them *how to plan* and *why to plan.*

Is planning the same at all class levels? The answer is No. The effectiveness and the detailed completeness of planning will increase with the efficiency and maturity of the student. It might be concluded that as a *beginning experience* the student will need a lot of help and attention; as a *middle experience* the student will need some suggestions and supervision; and as a *final experience* the student should be able to plan effectively by himself. Anyone would need a great deal of help to participate in some activity new to him. Then too he would become progressively independent as he gained in experience.

METHOD OF PLANNING

1. The beginning experience should be introduced by *indoctrination* to provide a basic background. The teacher should plan the first project with the class and proceed in a step by step manner, explaining and filling out each part of the plan sheet to be sure that the students know how to plan and why to plan.

2. The middle experience may be called *guided planning* in which case the student will have an understanding and a background of experiences. Here the teacher will act as a counselor to help the students with their special problems. Help should be given tactfully.

3. The final experience may be called *supervised planning* in which case the student accepts a problem or project and plans it by himself. Here the student planning activity becomes a student responsibility. Schweickhard states: "Each project should represent a problem to be solved, for which the boy can work out his own solution by mapping out a plan of performance based upon his knowledge and ability and supplemented by instruction sheets."[1]

There are possibly two other methods of planning which are used in some situations and in some cases by excellent teachers who unfortunately teach *projects* and not students.

1. One of these might be called *dogmatic teacher direction.* Here the students do not have to do any thinking or planning. The teacher tells them what to make and how to make it in a lock step manner with the emphasis on keeping the class together. This method is expedient for the teacher who wishes to make it easy for himself.

2. The other one might be called the *mental-verbal* method. In this case learning takes place by chance and in an incidental manner. This method is also expedient for the teacher who does not use instruction or planning sheets but keeps everything to himself mentally. The student learns by word of mouth instructions.

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3. Schweickhard, D. M., *Industrial Arts in Education* (Peoria, Ill.: The Manual Arts Press), 1929.
4. Ericson, E. E., *Teaching the Industrial Arts* (Peoria, Ill.: The Manual Arts Press), 1946.
5. Baysinger, G. B., and Silvius, G. H., *The Student's Planning Book* (Scranton, Pa.: International Textbook Company), 1943.

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[1] SCHWEICKHARD, D. M., *Industrial Arts in Education,* The Manual Arts Press, 1929, p. 249.

Student Planning Sheet

Name Robert Skoff
Estimated Time 2 hours 30 min.
Project Heart Shaped Cookie Cutter

Instructor's Approval A. C. Wenzel
Actual Time 2 hours
Date March 7, 1951

Source Information
1. *Sheetmetal Worker's Manual*—Broemel
2. *Hand Processes*—Delmar Pub. Inc.
3. *Operation Sheets*—C.S.T.C.
4.
5.
6.

Suggestions by Instructor
1.
2.
3.
4.
5.
6.

Sketch or Working Drawing

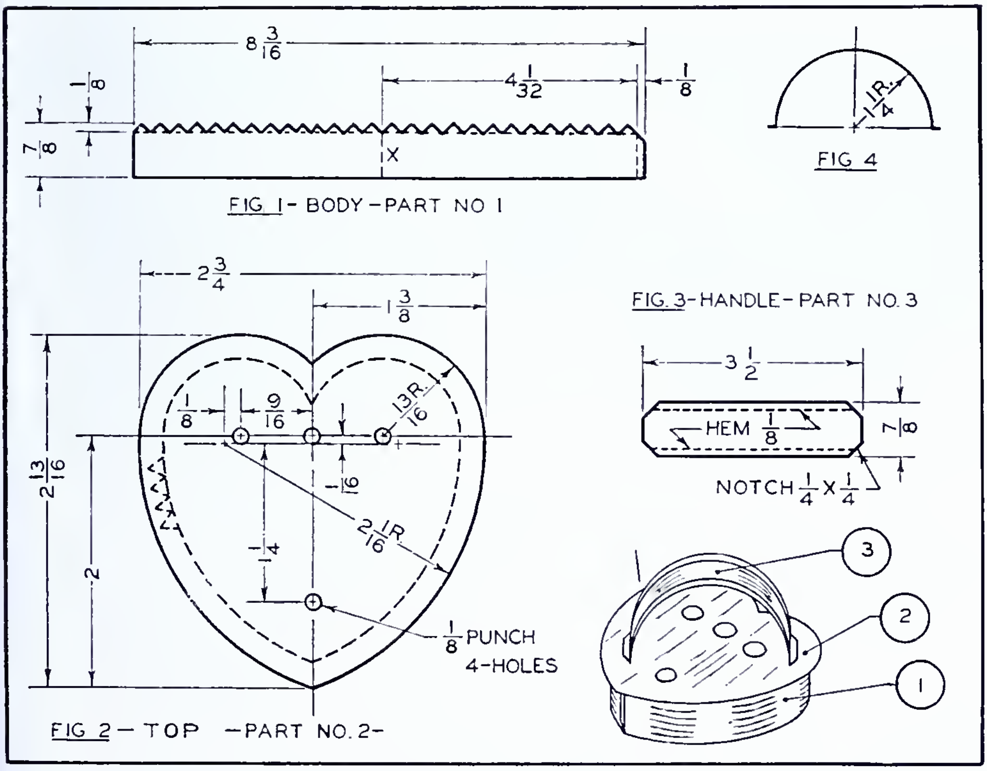
NOTE: Use other side of sheet if necessary.

STUDENT PLANNING SHEET*

Name Robert Skoff *Class* Shop 2 *Section* C *Bench No.* 7

How to make my project

1. Lay out body as shown in Figure 1, then cut to size with straight snips.
2. Break grain of body using the slip roll.
3. Bend notches on body to 90-deg. angle on beakhorn stake.
4. Bend body to approximately 60 deg. on line shown at 'X" in Figure 1 making sure notches are on the inside of the angle.



Heart shaped cookie cutter

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* This planning form was completed by a student in a sheet-metal shop class.

5. Form rest of body on conductor stake and use dotted line on Figure 2 as a pattern.
6. Solder body using ⅛-in. lap seam.
7. Lay out top as shown in Figure 2.
8. Cut to shape using combination snips.
9. Punch ⅛-in. holes as shown on Figure 2.
10. Sweat solder body to top.
11. Lay out handle as shown on Figure 3, then cut to size with straight snips.
12. Break grain handle piece and make hems (set B.F. at 3⁄32 in. closed lock), then form handle on conductor stake as shown in Figure 4.
13. Sweat solder handle to top.

Operations I need to know

1. How to make layouts.
2. How to use tin snips.
3. How to make a lap seam.
4. How to solder.

**5. How to use the B.F.
6. How to form on stakes.
7. How to use the slip roll.

Tools and equipment I expect to use

1. Combination square
2. Scriber
3. Prick punch
4. Dividers
5. Straight snips
6. Combination snips
7. Bar folder (B.F.)
8. Slip roll
9. Soldering copper
10. Stakes
11. Mallet
12. Hand punch
13. Gas furnace

Safety precautions I must observe

1. Be careful with hot copper.
2. Be careful when cutting sheet metal.
3. File smooth sharp edges.
4. Use first aid supplies for minor cuts.

Materials for my project

No. of pcs.	*Description*	*Material*	*Size*	*Cost*
1	Top	30-ga. tin plate	2¾ x 3 3⁄16 in.	....
1	Body	30-ga. tin plate	⅞ x 8 3⁄16 in.	....
1	Handle	30-ga. tin plate	1⅛ x 3½ in.	....
Total cost of project				________

** Check (X) operations which are new to you.